Vello A. Kuuskraa (vkuuskraa@adv-res.com), President
Michael Godec (mgodec@adv-res.com), Vice President
Advanced Resources International, Inc.

Testimony before the House Committee on Resources
Subcommittee on Energy & Mineral Resources

Hearing on the Vast North American Resource Potential of Oil Shale, Oil Sands and Heavy Oils

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Good Afternoon. I am pleased to address the House Subcommittee on Energy and Resources on the topic of increasing future domestic oil production from oil shale, oil sands, and heavy oils.

Our nation's oil basins are mature and in decline. In the past 20 years, domestic oil production has dropped by 3 million barrels per day, while demand for oil has continued to grow. As a result, imports now provide 60% of the oil consumed in the U.S., with serious implications for energy security. In fact, in his recent national address on energy, President Bush stated: *"Our dependence on foreign energy is like a foreign tax on the American people. It is a tax our citizens pay every day in higher gasoline prices and higher costs to heat and cool their homes. It's a tax on jobs and a tax that is increasing every year."*

However, the problem of declining domestic oil production is not due to a lack of domestic resources. Not including domestic oil shale resources, which others testifying today can address more effectively than I, undeveloped domestic oil resources in the ground (in-place) in the U.S. still total over 1,000 billion barrels. These resources include undiscovered conventional onshore and offshore oil; future growth of already discovered oil fields ("reserve growth"); "stranded" light oil resources amenable to carbon dioxide enhanced oil recovery (CO2-EOR) technologies; shallow and deep heavy oil amenable to thermal and other EOR technologies; residual oil in transition zones; and oil sands. These domestic resources could provide an additional 400 billion barrels of future technically recoverable oil, as shown in Table 1. The U.S. petroleum industry, as the leader in applying exploitation and EOR technology, faces the challenge of developing technology for economically producing this more challenging - - and more costly - - remaining domestic oil resource.

Now, let me focus more explicitly on two of the categories of domestic oil resources that are the topic of today's hearing - - heavy oil and oil sands. The U.S. still has very large volumes of undeveloped heavy oil and oil sands (sometimes called "tar sands"), estimated at 180 billion barrels originally in-place. Of this, about 100 billion barrels exists in heavy oil reservoirs, with another 80 billion barrels in oil sands prospects. However, unlike oil shale, this resource, is geographically quite dispersed, located in California (47 billion barrels), Alaska (44 billion barrels), Utah (19 to 32 billion barrels), Alabama, Texas and Wyoming (each with 5 to 6 billion barrels), and numerous other states such as Arkansas, Kentucky, Louisiana, Mississippi and Missouri, Figure 1.

Table 1. Potential Remaining Undeveloped Domestic Oil Resources

	Original Oil in Place (Billion Barrels)	Technical Recovery Potential (Billion Barrels)
Undiscovered Conventional [1,2]	360	179
Reserve Growth [3,4]	210	111
Stranded Light Oil [5]	280	80
Heavy Oil [6]	100	20
Oil Sands	80	10
Residual Oil in Transition Zones [7]	100	Unknown
Total	**1,130**	**400**

1. Source: USGS National Assessment of Oil and Gas Resources Update (USGS; October 2004) Conventional Oil Resources (40.43 billion barrels) and Continuous Oil Resources (2.13 billion barrels). Oil in–place estimated by assuming 33% recovery efficiency. Assumes 50% recovery efficiency with enhanced oil recovery for undiscovered.
2. Source: Assessment of Undiscovered Technically Recoverable Oil and Gas Resources of the Nation's Outer Continental Shelf, 2003 Update (MMS Fact Sheet, December 2004).
3. Source: Estimates of Inferred Reserves for the 1995 USGS National Oil and Gas Resource Assessment (USGS OFP 95-75L, January 1997). Assumes 50% recovery efficiency with enhanced oil recovery for reserves growth.
4. Source: Assumptions for the Annual Energy Outlook 2004 (EIA, February 2004).
5. Source: DOE/FE Basin Reports, (Advanced Resources, 2005), recoverable from existing and future "stranded" oil resources estimated by Advanced Resources.
6. Source: A Technical and Economic Assessment of Domestic Heavy Oil (V.A. Kuuskraa and M.L. Godec, 1987). Recoverable estimated by Advanced Resources.
7. Source: Preliminary Estimates by Advanced Resources Int'l and Melzer Consulting (2005).
8. Source: Major Tar Sand and Heavy Oil Deposits of the United States (Lewin and Associates, Inc., July 1983). Recoverable estimated by Advanced Resources.

Application of thermal enhanced oil recovery (EOR), particularly steam injection, has enabled industry to recover and produce a portion of the domestic heavy oil resource, from the geologically most favorable, shallow portion of the resource base, primarily in California and Alaska. For example, heavy oil production in California provided 510,000 barrels per day, and in Alaska provided 27, 000 barrels per day (both in 2003). While heavy oil production has been declining in California, it is counterbalanced, somewhat by increasing production in Alaska, Figure 2. To date, we have recovered 17 billion barrels of heavy oil, with 2 billion barrels in proved reserves.

In spite of impressive efforts by industry, the great bulk over 160 billion barrels of the resource in deep heavy oil reservoirs and in oil sands is not recoverable with today's oil recovery technology. Based on our past work, we estimate that another 30 billion barrels could become technically recoverable with advances in oil recovery technology.

Figure 1. Size and Distribution of U.S. Heavy Oil and Oil Sands Resources in the United States

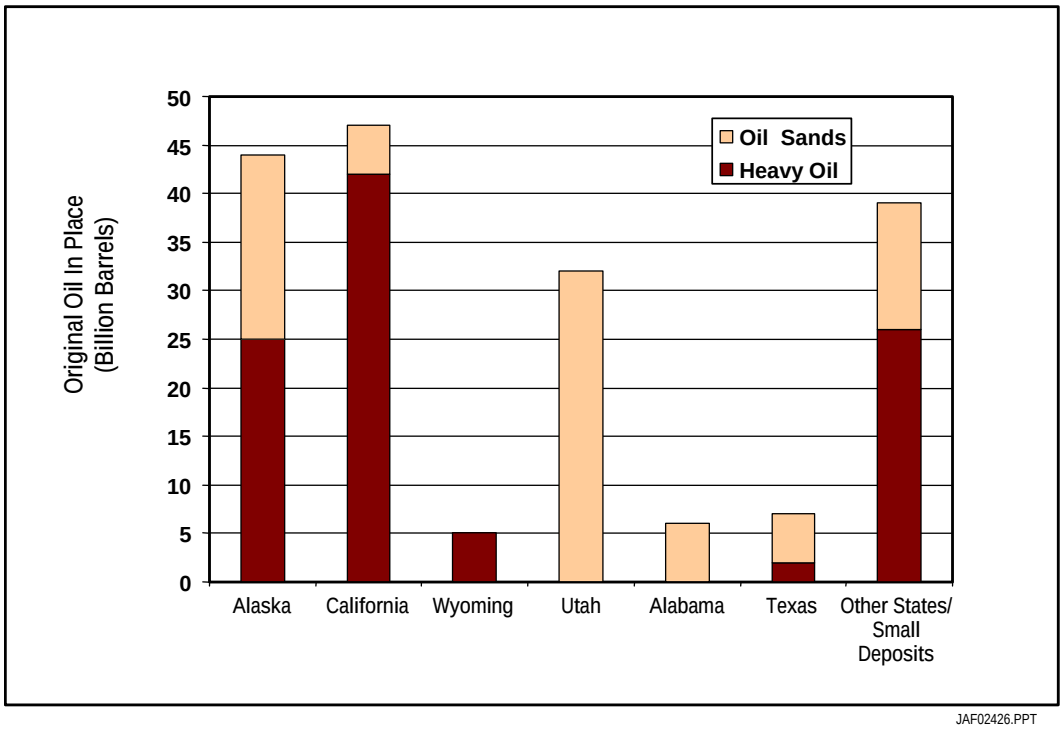
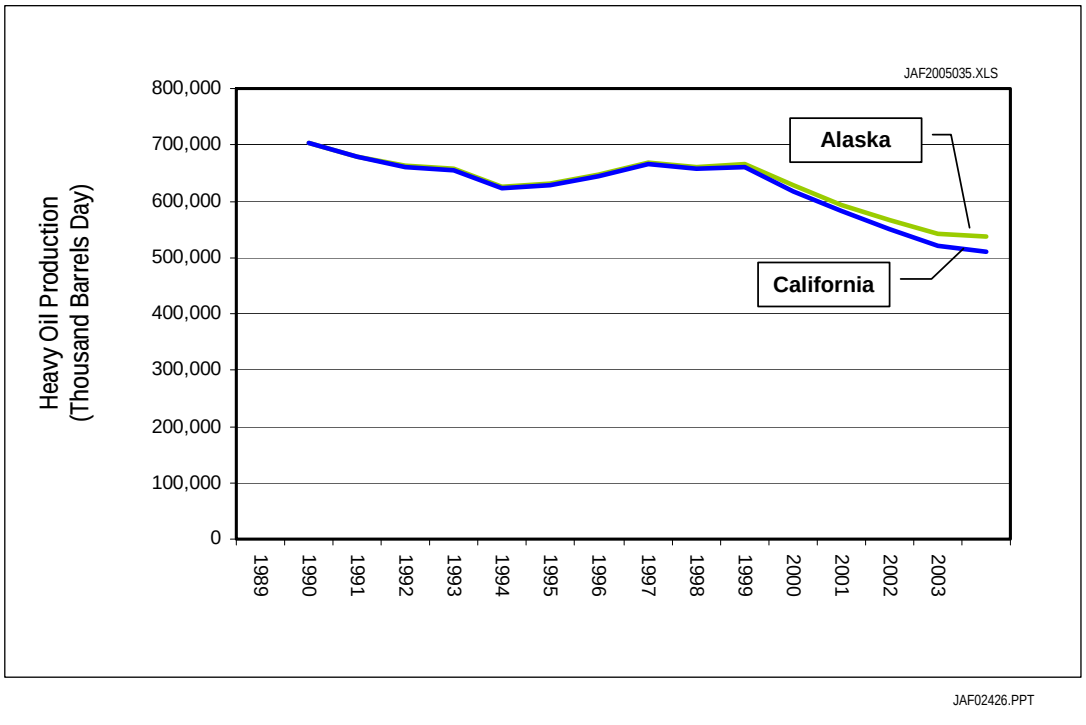


Figure 2. Heavy Oil Production in California and Alaska



An important characteristic of heavy oil and the bitumen in oil sands is that nature, over geologic time and with heat and pressure, has already converted these resources from immature source rock, such as kerogen in oil shale, to a crude oil. As such, compared to oil shale, nature has taken care of half of the challenge. Still, because of its high viscosity (low API gravity), the remaining heavy oil and oil sand resource is essentially immobile. Injection of heat or solvents, or the direct mining of the resource, is required to efficiently recover and produce crude oil from heavy oil and oil sands. Given the challenge, a prudent technology development strategy would be to first address heavy oil, then oil sands, and then oil shale.

Introduction of advanced heavy oil and oil sands technology, including technologies such as horizontal wells and CO2-based enhanced oil recovery technologies, would provide a valuable start. In addition, adaptation of new technologies being tested in Canada, such as SAGD (steam assisted gravity drainage), VAPEX (the use of a combination of solvent and heat), and the "top down combustion" process, could help further unlocking the domestic heavy oil and oil sands resource potential.

Of particular value would be the development and introduction of state-of-the-art "zero emission" heavy oil and oil sands recovery processes, which could involve an upgrading and refining system involving gasification of heavy oil residue to produce steam, hydrogen, and electricity, while productively using the by-product CO2 that would otherwise be emitted to the atmosphere for recovery of deep heavy oil. Not only would this achieve a positive energy balance, but it would provide one more "market-based" technology option for reducing CO2 emissions to the atmosphere.

Several steps could be taken to overcome the barriers currently facing the development of domestic heavy oil and oil sand resources:

- *Reducing current geological, technical, and economic risks could be accomplished through an aggressive program of research and field t*ests. Optimizing the performance of current heavy oil and oil sands recovery practices and expanding its application will help lower the geological, technical, and economic risks involved with these enhanced oil recovery technologies. This was the pathway used by the DOE and the Gas Research Institute to reduce geologic and technical risks which helped commercialize domestic unconventional gas, that now accounts for over one-third of domestic natural gas production. State-Federal partnerships devoted to technology transfer would help address the barriers that currently inhibit the development and production of domestic heavy oil and oil sands. Also, engaging in collaborative Canadian/U.S. efforts such as sharing technology and conducting jointly-funded field R&D on oil sands and heavy oil could help facilitate application of the best technologies appropriate for U.S. heavy oil and oil sands resources.

- *Investments in new technology development would lead to higher oil recovery efficiencies.* New models of public-private partnerships focused on developing domestic oil resources could enable the launching of key field projects to demonstrate higher oil recovery concepts and advanced technologies. Moreover, demonstrating an integrated "zero emissions" steam, hydrogen and electricity generation system, that provides "EOR-

Ready" CO2 from the residue products from heavy oil and oil sand upgrading and refining, would provide an efficient approach toward future oil recovery.

- *Providing "risk-mitigation" incentives* to provide protection against sharp drops in oil prices for those producers willing to try new technologies. At the Federal level, recent modifications proposed for the Section 43 EOR tax credits could help accomplish this, as could royalty relief for resources underlying Federal lands. At the state level, severance tax relief could also help provide risk mitigation incentives.

- *Update the data and information base on domestic heavy oil and oil sands*. The initial studies of domestic heavy oil and oil sands, and the ones still used by Congress and other energy policy makers, and those quoted today in this testimony, were prepared by the two authors of this Congressional Testimony for the Interstate Oil and Gas Compact Commission (IOGCC) nearly 20 years ago. Since these past studies were conducted, much has been learned about the resource base, and significant advances in heavy oil and oil sands extraction technology has taken place. An up-to-date resource and technology study on domestic heavy oil and oil sands could provide insights on formulating policies, initiatives and technology for more effectively developing this large oil resource, helping increase domestic oil production.

With these actions, domestic heavy oil and oil sands could provide an additional 500,000 barrels per day of production in ten years, and an additional 1 to 1.5 million barrels per day of domestic oil production by 2025, particularly from Alaska, California, Texas, Utah and Wyoming.

Thank you very much for providing us with the opportunity to testify before this subcommittee today.